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LIFE-HISTORIES OF THE NEW YORK SLUG CATER- PILLARS.—VII-IX.

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PLATES I-II.

Tortricidia fasciola Herrich-Schæffer.

- 1854—*Limacodes fasciola* Herrich-Schæffer, Ausser. Schmett. fig. 186.
- 1860—*Limacodes laticlavata* Clemens, Proc. Acad. Nat. Sci. Phil. XII, 157.
- 1864—*Lithacodes fasciola* Packard, Proc. Ent. Soc. Phil. III, 345.
- 1882—*Limacodes fasciola* Grote, Check List, 17.
- 1886—*Lithacodes laticlavata* Hy. Edwards, Ent. Amer. II, 9.
- 1891—*Limacodes fasciata* Smith, List Lep. 28.
- 1892—*Lithacodes fasciola* Kirby, Cat. Lep. Het. I, 555.
- 1894—*Tortricidia fasciola* Neumoegen & Dyar, Journ. N. Y. Ent. Soc. II, 76.

LARVA.

- 1860—Clemens, Proc. Acad. Nat. Sci. Phil. XII, 157.
- 1872—Lintner, 26th Rept. N. Y. State Cab. Nat. Hist. 149.
- 1883—Saunders, Ins. Inj. Forest Trees, 179.
- 1893—Packard, Proc. Am. Phil. Soc. XXXI, 101.
- 1894—Dyar, Ann. N. Y. Acad. Sci. VIII, 221.

SPECIAL STRUCTURAL CHARACTERS.

Dorsal space broad, flat, narrowing to the ends in a short rounded margin, gently arched; lateral space broad, oblique, slightly concave, narrowing to the ends; subventral space small, retracted. Subdorsal ridge slight, angulated, smooth at maturity, the tubercles disappearing during ontogeny and finally the setæ also. Lateral ridge moderately prominent, also smooth at maturity. Head and joint 2 well retracted. Segments unusually distinct, the incisures marked, cleft-like. Dorsal outline elliptical, joint 13 forming a broad quadrate termination. Depressed spaces (1) to (8) present, deep, but not large, the margins

rounded, not sharply defined; (4) is evidently situated in the incisure on the posterior edge of its corresponding segment. (1) and (4) are the largest and have distinct dark centers, both transversely elongated. Skin granules large, rounded, contiguous, rather confused and irregular so that the surface appears creased and coarsely shagreened rather than covered with distinct granules. In stage I the setae are arranged as in *Apoda y-inversa* and have the same structure. Their course of reduction in the later stages is also the same. The skin granules when first appearing are of two forms, numerous fine ones and a few larger ones which form short spines on the ridges. These persist till the last stage, when the granulation is rendered uniform, but confused.

The coloration is a light yellowish green, marked obscurely with yellow, adapted to the color of the leaves it feeds on.

AFFINITIES, HABITS, ETC.

This larva is nearly allied to *Apoda y-inversa* and to what I now think is *A. biguttata*,* also in a less degree to the Packardias. It differs from these in the peculiar granulation. In referring the species to *Tortricidia*, the characters of the moth alone were considered. On the whole the species seems not strictly congeneric, phylogenetically, with either *Apoda* or *Tortricidia*, and the name *Lithacodes* would be justified, if any good characters could be found in the moth. From *Tortricidia pallida* and *Heterogenea flexuosa* (?) this larva differs in the slight development of the depressed spaces which are as in *Apoda*. The shape is similar in both.

T. fasciola ranges to the north, probably as far as *T. pallida* and it also ranges well to the south. It is an abundant species in New York, the larvæ always well separated and living on a variety of plants, for the most part low. Occasionally the larvæ will be found on very low shrubs. They are not particular as to the position of their food plant in regard to light, being found in open as well as dark woods. The small eggs are laid singly on the backs of the leaves in July and the larvæ mature in September. There are seven larval stages, occasionally eight, the larvæ feeding in stage I, as in all the smooth Eucleids. †

A newly hatched larva was found by me on wild cherry and carried through to maturity. I am indebted to Miss Morton for fertile eggs, from which also I followed out the life history.

* Described as *Apoda y-inversa*, Ann. N. Y. Acad. Sci. VIII, 221.

† Our statement to the contrary in the case of *Apoda y-inversa* is an error.

CRITICISM OF PREVIOUS DESCRIPTIONS.

Dr. Packard's description is the only one of importance. His figure of Stage I is not drawn in a detailed manner, many of the setæ being omitted or incorrectly drawn. The description is like the figure, but is not corroborated by my observations. I think the setæ at the extremities were not carefully examined, and the spiracles have been put in in the wrong place. The lowest row of short setæ in the figure probably represents the subventral row, not shown in my figure (Plate I, Fig. 1) and the spiracles should be above it. Besides stage I, Dr. Packard describes the last three stages, V, VI and VII (marked III?, IV? and "last stage"). I find the descriptions excellent. The dorsal and lateral depressed spaces are quite fully described and located, though the upper segmental lateral (3) are said to be situated "on a suture"* which is not the case. I also object to the centers of the dorsal depressions (1) being called warts, and the broken yellow line along the lateral ridge being described in the same series as the lateral depressed spaces.†

DESCRIPTION OF THE SEVERAL STAGES IN DETAIL.

Egg.—Elliptical, narrower than usual, not greatly flattened, the upper surface arched; size $.7 \times .5$ mm., height about .2 mm. and therefore unusually high in proportion. Reticulations obscure, irregularly hexagonal, linear. Color whitish translucent with a very faint yellow tint. They hatch in eight days.

Stage I. (Plate I, Fig. 1).—Head whitish, eye black, mouth brown. Body highest at joints 3-4, rather square. Setæ arranged as in *Apoda y-inversa* and with the same structure, colorless. Body all whitish, without marks. The subdorsal setæ on joints 5, 7, 9 and 11 lean out, alternating with the others; all have expanded cleft tips, the subdorsals on joints 4 to 12 with a short spur near the base. The lateral setæ on joint 5 leans upward more than the others. After eating, the blood becomes pale green and the dark alimentary canal shows by transparency. Length .7 to 1.1 mm.

Stage II.—Elliptical, tail squarish; dorsal space broad, lateral moderate, subventral small; ridges prominent, tubercular; two setæ on

* "On each of the lateral slopes of the plateau are four rows of lemon yellow spots, the highest and first being a row of minute transverse spots situated on the suture."

† "The fourth row is on the margin of the body, and is a broken series of short lines."

subdorsal ridge, one on lateral ridge of abdomen (Plate I, Fig. 4), a secondary setæ above the spiracle and the two of subventral row below it. Upper setæ long, stiff, black at apex. Skin with sparse granules produced into slender spines, longest and most numerous along the ridges at the bases of the setæ; a few distinct spines in the dorsal space, but in the lateral area mostly fine granulations only. Color translucent pale greenish, no pigment. Segments well marked. Length 1 to 1.6 mm.

Stage III.—Body moderately elongated, elliptical, more elongated than *T. pallida*. Skin very finely granular, frosted under a half-inch objective, which hardly resolves the fine granules; conical, clear, pointed tubercles, much larger than the granules, are distributed in a single row along the low, rounded latticed ridges, becoming pale secondary spines on the tubercles. Tubercles low and rounded, the subdorsal ones with two, lateral with one large, dark, stiff setæ. Ridges prominent, normal. Color pale green, alimentary canal dark. Toward the end of the stage a faint yellow line appears along the subdorsal ridge and yellow dots in the dorsal depressed spaces (1); all the depressed spaces faintly shown. Length 1.5 to 2.6 mm.

Stage IV.—Ridges well marked, tubercular, setæ black. Tail quadrate, composed of the last abdominal segment. Depressed spaces as in *T. pallida*, but ill defined, the separating latticed ridges obscure. Skin finely granular, the larger spinose granules few in number except on the ridges. Color light green, dorsum dark, translucent. A narrow yellow line below the subdorsal ridge, a series of yellowish dorsal rings in the depressed spaces (1), seven of them distinct; a row of lateral whitish spots (4). Length 2.5 to 4 mm.

Stage V.—Elliptical, tail quadrate, dorsal space moderate, lateral broad, oblique, subventral small, retracted. Ridges only slightly tubercular. Latticed ridges low, with both coarse and fine granules as before, the former becoming pale spines on the ridges, especially the lateral one (Plate I, Fig 5). Color yellowish green, a narrow, wavy, yellow, subdorsal line; yellow rings in depressed spaces (1), two yellow dashes in (4), separated by a green spot; the other depressions show as yellow dots. There may be a distinct dark green spot between spaces (1) and (2) in certain larvæ. Length 3.5 to 6.7 mm.

Stage VI.—(Plate I, Figs. 2 and 3.) Ridges slightly tubercular with distinct black setæ, but without secondary spines; shape elliptical, the tail quadrate as in the mature larva. Skin confused granular, the granules resulting from the two kinds of the former stage, alike now except in size, somewhat flattened in the dorsal space and irregular. Yellow-

ish green, a narrow, slightly wavy subdorsal yellow line, free at the ends; depressed spaces (1) to (6) yellow, (1) green centered, (4) bisected by green, (6) above the lateral ridge, nearly divided by the incisure; traces of a white subventral line and a broken yellow one on the lateral ridge. Length 5 to 7.7 mm.

Stage VII.—(Plate I, Fig. 6.) Smooth, the setæ absent; shape as described. Depressed spaces moderately developed, without sharp edges. Skin granules irregular, confused. Color yellowish green, dorsal space and upper half of lateral space pigmented, below more translucent. Subdorsal line yellow, narrow, waved by slightly darker green segmental dots above; lateral line broken, faint, all joining on joint 13, the subdorsals also on joint 3 anteriorly. Subventral edge white. Depressed spaces (1) to (6) pale yellow, (1) and (4) plainly green centered. Length 7 to 13 mm.

Food-plants observed.—Wild cherry, white birch, bayberry, dogwood, chestnut, sugar plum, oak, linden, maple, beech, hop hornbeam, hickory and huckleberry.

Adoneta spinuloides Herrich-Schæffer.

1854—*Limacodes spinuloides* Herrich-Schæffer, Ausser. Schmett. figs. 187, 188.

1860—*Adoneta voluta* Clemens, Proc. Acad. Nat. Sci. Phil. XII, 158.

1864—*Cyclopteryx leucosigma* Packard, Proc. Ent. Soc. Phil. III, 345.

1865—*Limacodes ferrigera* Walker, Cat. Brit. Mus. pt. XXXII, 486.

1882—*Adoneta spinuloides* and *leucosigma* Grote, Check List, 17.

1894—*Adoneta spinuloides* and *leucosigma* Neumögen & Dyar, Journ. N. Y. Ent. Soc. II, 71.

LARVA.

1860—Clemens, Proc. Acad. Nat. Sci. XII, 158.

1882—Ballard, Papilio, II, 83.

1883—Edwards & Elliot, Papilio, III, 129.

1892—Beutenmüller, Bull. Am. Mus. Nat. His. IV, 68.

1893—Packard, Proc. Am. Phil. Soc. XXXI, 92.

1894—Dyar, Ann. N. Y. Acad. Sci. VIII, 213.

SPECIAL STRUCTURAL CHARACTERS.

Dorsal space moderately broad, narrowing to the ends, lateral and subventral spaces both moderate, subequal, the latter scarcely retracted. Body elongate, narrow, rising rather rapidly to joint 5, thence sloping to joint 13. Ridges all slight, subdorsal indicated by change in direction between back and sides, lateral very slight, the row of horns forming most of it. Horns short and small, rounded, the subdorsals on joint 3 to 5 and 11 the largest, those on 8 and 13 next, the rest all

quite small. Skin densely and coarsely covered with subconic clear granules, uniformly and without distinct depressed spaces, (1) indicated by paired white dots in a slight intersegmental furrow, (3) just indicated, whitish, (4) as faint pale rings. In the subventral space large rather indistinct hollows (7) alternate with the spiracles, forming perpendicular segmental ridges, reaching to the subventral edge. Caltropes are present in the last stage only, in little patches on top of the lateral horns on joints 6 to 11 and large patches on lateral of 12 and subdorsal of 13.

The first stage does not differ from that of *Euclea delphinii* and the mature larva, though differing in shape, is also adapted for concealment by its coloration. Its defensive armor is even more reduced than in the *Euclea* mentioned.

AFFINITIES, HABITS, ETC.

In the shortened horns the larva closely resembles *Euclea delphinii*. It is more generalized than this species since there are no detachable spines and the bright colors remain. It is more specialized than *E. indetermina* in the shortening of the horns and the alteration in shape, which resembles *Parasa chloris*, except in the absence of a tail. Our two *Eucleas*, the *Parasa* and *Adoneta*, form a closely allied group.

The eggs of *Adoneta* are laid in July and the larvæ mature in September as usual. The larva is a low feeder and, as several eggs are not infrequently laid at once, several larvæ are usually found on the same plant. The bright colors of the larva possibly have little warning effect as the spines are nearly functionless; but they may serve rather as in the smooth *Eucleids* to suggest patches on the leaves.

I am indebted to Miss Morton for the eggs of this species. She has also furnished the material for Dr. Packard's descriptions and thus our present knowledge of this life history is entirely dependent upon her.

CRITICISM OF PREVIOUS DESCRIPTIONS.

Though there are but few references to this larva, it may be said to be well known, owing to the early date of Clemens' writing and to Dr. Packard's very full and excellent account. In my description the lateral horns are located below the spiracles; the true position is given by Edwards & Elliot. Mrs. Ballard's "strap-shaped lines, buttoned at either end," are to be interpreted as transverse streaks between the paired dots of depressed spaces (1). Dr. Packard describes the "whole life history" in five stages. There are really seven, and Dr. Packard has doubtless been misled by a too hasty generalization from observations of the *Notodontidæ*. The stages which he gives seem to be I,

III,* IV, VI and VII, which illustrates the life history very well, though it is not a complete account of it, as it purports to be. The description and figure of stage I are in error in placing a lateral horn on joint 5. In stage "IV" (= VI) the paired glandular dots (1) are again called "warts," and in the last stage he says "these dots appear to be modified surface dorsal piliferous warts . . ." I do not think they are. The appearance is glandular and I have seen in *T. fasciola* a small drop of moisture in the location of each one of these depressed spaces which I believe was the secretion, not at the time evaporated. Besides, all the normal primary warts are situated elsewhere, and there are no warts, primary or secondary, in the whole order Lepidoptera in such a position (in the incisures). That they are not secondary warts is indicated by the fact that they are not more distinct in the early stages and never bear any setæ, as would be expected if they were degenerate warts.

Dr. Packard regards *Adoneta* as one of the more generalized forms of its group, and with this I agree, though I think it is not so generalized as *Euclea indetermina*. He says: "This larva indicates in some points of its structure its descent, and that of the group to which it belongs, from the Attacinæ; these points are the setiferous tubercles and the distinctness of the segments from one another, the sutures being well marked."

Recently Dr. Chapman also falls in with this view. He says (Trans. Ent. Soc. London, 1896, p. 584): "My observations on the spines of *Limacodes* and *Eacles*, and again of these and Sphinges and Saturnids . . . and the observations of Poulton and Weissman, on the larvæ of *Agilia*, Sphingidæ, etc., leave no room for doubt that all these families are related . . ." The question of the relation between the Sphingides and Saturniides, which Poulton, Weissman and Müller discuss, is aside from the present matter, and cannot be answered with the same certainty till some more generalized Sphingidæ are found. But the relationship which is claimed between the Eucleidæ and Saturniides on account of the spines, seems to me of exactly the same nature as that between the species of *Apatela* and the several families in which Mr. Butler once distributed them, based with equal probability on the similar structure of the hairs.†

* Mr. Bridgman is quoted as stating that this stage was drawn "after the first molt." However, I imagine that the true first molt escaped his observation, as I do not suppose he was looking for a molt before the larva had eaten anything.

† The stinging spines of the Saturnians (*Hemileuca*, etc.) are not ancestral to the whole group, nor are they so in the Eucleidæ, which I expect to illustrate in a genealogical tree to be given at the end of these articles.

DESCRIPTION OF THE SEVERAL STAGES IN DETAIL.

Egg.—Elliptical, flat, $1.1 \times .7$ mm., milky whitish when laid on glass, reticulations obscure. Laid singly or in patches of two to ten, slightly overlapping. They hatch in seven days.

Stage I.—(Plate I, Fig. 8) Structure as in *Euclea*; eleven horns in subdorsal row, nine in lateral row, the one on joint 5 absent. Three setae on each horn, tapering, slightly enlarged and notched at the tips. Color uniform, translucent whitish; skin smooth; head white, eye black. Length .9 mm. The larva does not feed in this stage and molts in two days from the time of hatching.

Stage II.—Head white, eye black, mouth brown; horns spined, the long subdorsals, with a bunch of black-tipped spines, the short ones with one spine; lateral row moderately spined. Color opaque whitish; dorsal depressed spots (1) paired, greenish, two pair on the incisures 3-4 and 4-5, those on interspaces 8-9 and 9-10 connected into a transverse streak. No marks except a white line along the subdorsal ridge. Length, .9 to 2.2 mm.

Stage III.—Thickest through joints 4-5; dorsum flat, sides nearly perpendicular; lateral ridge moderate, shape as in the mature larva. Subdorsal horns on joints 3, 4, 5, 8, 11 and 12 large, rounded, not long, the others very small, but with several spines, lateral horns all small. Color whitish, dorsum and upper half of sides green from food; a white subdorsal line, thickened at the large horns, causing the dorsal space to widen and contract. In the wide spaces on joints 4-5 and 6-7 a rounded patch of pale purplish pigment, and in the space 9-10 a smaller whitish patch. Skin finely clear granular except on the horns. Dorsal dots (1) white. Later all the dorsal patches become purple-red and there is another on joints 3-4; subdorsal horns faintly yellowish. Length, 2.1 to 3.3 mm.

Stage IV.—Structure as in the mature larva. Skin clear granular, the paired white dots (1) visible where the ground color is purple. Markings at first as at the end of the last stage; later the subdorsal horns on joints 3 to 5 are tipped with red; a yellow line on subdorsal ridge, bent up at the large horns, the dorsal space filled in with dark purple except in a space from joint 7 posteriorly to joint 9 anteriorly. Sides green, the lateral horns colorless. Length, 3.2 to 4.7. mm.

Stage V.—Horns as in *Euclea delphinii*, the spiracle on joint 5 moved up. Long horns on joints 3 to 5 and 12 red tipped, the short ones pale yellow, lateral ones colorless. Colors as before, the waved

purple patches extending on joints 3 to 7 and 9 to 12, separated by a green space. Spines with black tips, rather delicate; skin closely and finely clear granular. Depressed spaces (1) and (2) indicated as glandular dots, large lateral ones (4) as ill defined hollows, all obscure. Head greenish, eye black. Length, 4 to 6.5 mm.

Stage VI.—As before; patches dark reddish purple. Subdorsal horns on joint 6 and 7 moved outward a little, not in line with the others; that on 8 rather larger than the other short horns. A distinct green line edges the subdorsal band below. Dorsal purple band broken as before or continuous, incised at the large horns. Sometimes the subdorsal horns of 11 and 13 are red tipped as well as 3 to 5 and 12. The purple band is bordered with crimson; a pale dorsal line; no caltropes. Length 5.7 to 9 mm.

Stage VII.—(Plate I, Figs. 9, 10 and 11) Appearance as before, but there are caltrops patches (Plate I, Fig. 14) on top of the lateral horns of joints 6 to 12 and a large one on joint 13. Dorsum purple, darker at the edges, incised by yellow on joints 4, 5, 8, 11 and 12; a straight pale dorsal line and the glandular dots (1) whitish, two pairs on incisures 3-4 and 4-5, one pair in the other incisures. Addorsals (2) indicated as tiny pale dots, seen on joints 9 and 10. Long horns on 3, 4, 5, 8, 11, 12 and 13 red, the rest yellow, the largest .6 to .7 mm. long, the shortest rounded. Sides green, darker below both ridges, a broken whitish line along lateral ridge. Depressed spaces (4) show faintly and an ill defined hollow between the segments subventrally (7). Skin with low conic clear granules (Plate I, Fig. 12); spines small, black tipped (Plate I, Fig. 13). Length 8.2 to 11.8 mm.

Besides this, the usual form, examples occur with more red, or with less.

Form A.—Normal; no red except the subdorsals of 3 to 5, 8, 11 and 12, and the lateral of 3. Sides green, a broken yellow line on lateral ridge.

Form B.—Subdorsal horns 3 to 13 and lateral 3 all red; some yellow shading in the lateral space, the lateral line nearly continuous.

Form C.—Horns red and a vermilion stripe connecting their bases on joints 3 to 12; purple marks with a crimson edge and a blurred, irregular, crimson band in the lateral space, shading into the subdorsal red anteriorly; below it a yellowish or whitish shading.

Form D.—Subdorsal horns on 3 reddish, all the rest yellow; dorsal purple band pale, edged with green inside the yellow line, divided by yellow on joints 8, 11 and 12.

Food-plants observed.—Willow, oak, wild cherry, bayberry, linden, witch-hazel, chestnut, beech and sour-gum (*Nyssa*).

EXPLANATION OF PLATE I.

Tortricidia fasciola.

- Fig. 1. Larva in stage I, side view, enlarged.
 " 2. Larva in stage VI, side view, enlarged.
 " 3. The same, front view.
 " 4. One segment, stage VI, showing setæ.
 " 5. Skin granules at one of the setæ of lateral row.
 " 6. Mature larva, enlarged, dorsal view.
 " 7. Moth of *T. fasciola*.

Adoneta spinuloides.

- " 8. Larva in stage I, side view, enlarged.
 " 9. Mature larva, side view, enlarged.
 " 10. The same, front view.
 " 11. The same, back view.
 " 12. One of the short horns of subdorsal row and adjacent skin granules.
 " 13. A single spine, enlarged.
 " 14. Caltropes from a lateral horn.
 " 15. Moth of *A. spinuloides*.

Euclea indetermina Boisduval.

- 1864—*Callochloa vernata* Packard, Proc. Ent. Soc. Phil. III, 339.
 1882—*Parasa chloris* Grote, Check List, 17.
 1891—*Parasa viridus* Dyar, Trans. Am. Ent. Soc. XVIII, 154.
 1891—*Parasa viridus* Smith, List Lep. 28.
 1893—*Euclea indetermina* Dyar & Doll, Ent. News, IV, 311.
 1894—*Euclea indetermina* Neumoegen & Dyar, Journ. N. Y. Ent. Soc. II, 68.

LARVA.

- 1797—Smith & Abbot, Lep. Ins. Ga., pl. 73.
 1832—Boisduval, Cuvier's An. Kingd. (Griffith), Pl. 103, Fig. S.
 1852—Harris, Ins. Inj. Veg. 323.
 1858—Duncan, Nat. Libr. XX, Pl. 21.
 1878—Andrews, Psyche, II, 271 (as *Parasa chloris*).
 1885—Edwards & Elliot, Papilio, III, 128.
 1885—French, Can. Ent. XVII, 161.
 1893—Dyar & Doll, Ent. News, IV, 311.
 1894—Dyar, An. N. Y. Acad. Sci. VIII, 214.

SPECIAL STRUCTURAL CHARACTERS.

Dorsal space broad, narrowing only slightly at the ends, curving down anteriorly and posteriorly at joints 3-5 and 11-13. Sides nearly

perpendicular, the lateral and subventral areas practically continuous, the latter not retracted, spiracles exposed. Elongate, subcylindrical, the subdorsal ridge marking the change in direction of back and sides; lateral ridge slight. Horns well developed, irregular, well armed with strongly stinging spines. Subdorsals on joints 3 to 5, 8, 11 and 12 long, those on 5, 8, 11 and 12 longest, 6, 7, 9 and 10 very short; lateral horns moderate, those on joints 3 and 4 longest, that on 5 absent. Depressed spaces feebly developed, (1) to (4) (7) and (8) indicated by obscure dark, impressed dots, (1) paired. Skin densely finely spinulose-granular, the granules colorless. Patches of caltropes are present on the lateral horns of joints 6 to 13 and subdorsal horn of 13, but no detachable spines. The larva is very brightly colored. In the first stage the horns have the structure and arrangement of *E. delphinii*, three setæ from the apex of each.

This larva stands near *Sibine stimulea* in degrees of specialization. Its skin structure is higher, but the detachable spines are absent and the coloration is less diversified. It is, therefore, on the whole, a little lower than *Sibine*. It stands, perhaps, nearest the main stem of the spined Eucleids of any of our species. The horns at maturity are scarcely modified in relative proportions from the condition in stage I; the primitive bright warning colors are present and the urticating spines are in full functional activity, neither as yet affected by degeneration. The shape is more like that of an ordinary lepidopterous larva than usual. Therefore, we may regard *E. indetermina* as, on the whole, most like the ancestor of the spined Eucleids of any New York species, exclusive of *Phobetron pithecium*, which represents a still older condition.

AFFINITIES, HABITS, ETC.

This species is a typical representative of the group of spined Eucleids. Its near allies are found throughout South America and in India. Our nearest species is *Euclea delphinii*. The moth, however, so closely resembles that of *Parasa chloris* that the two species were for a long time confounded. They were separated by Grote in 1881, but Herrich-Schaeffer's figure was not correctly identified. It was suggested by Andrews, from the structure of the larva, that the species should be placed in *Euclea* rather than in *Parasa*, and this opinion is confirmed by the venation of the moth.

E. indetermina has a southern range. It occurs around New York City, but seems to be entirely absent from the Hudson valley. It is rather local in its appearance, often being common in certain localities

and absent in others near by. Though not gregarious many are often found on the same bush. They are low feeders, not occurring on trees to any extent.

The eggs are laid during July and the larvæ mature toward the middle of September. They remain on the under sides of the leaves in spite of their very conspicuous coloration. The effect of a touch of their spines is about the same as that of *Sibine stimulea*. The larvæ have eight stages, occasionally nine. Two examples bred from eggs of the same moth varied in this respect. They do not feed in stage I, which is rapidly passed through.

I am indebted to Miss Morton for obtaining for me the eggs from moths bred from larvæ part of which I collected and part obtained from Mr. Doll.

CRITICISM OF PREVIOUS DESCRIPTIONS.

All of the references given are to figures or descriptions of the mature larva, none of them going into structural details. The two best are that of Professor French (1885) and my own (1894). I notice nothing important of a positive nature to criticize except that in Prof. French's account the segments from which the horns are said to arise are not quite accurately numbered.

DESCRIPTION OF THE SEVERAL STAGES IN DETAIL.

Egg.—Singly, or in small groups, slightly imbricated. Elliptical, flattened, translucent pale ocher yellow on glass, 1.5 x .9 mm.; reticulations obscure, visible only in a strong light, rounded hexagonal, nearly linear, somewhat irregular. No special characters. They hatch in nine days.

Stage I.—(Plate II, Fig. 1.) Not different in structure from *Euclea delphinii*, the horns proportioned the same, each with three setæ with slightly swollen tips. Color rather dark yellow, shining, the long horns whitish. Segments well marked; skin smooth. Shape as usual, elongate, squarish, the horns low conical, prominent, their bases contiguous. Length 1.1 mm. The larvæ do not feed in this stage.

Stage II.—Subdorsal horns on joints 3, 4, 5, 8, 11 and 12 large, rounded; the rest small, all furnished with stinging spines; the short subdorsals (joints 6, 7, 9, 10) bear only one spine and are crowded up adjacent to the next large horn. Spines pale, black tipped. Ridges whitish, but dorsal and lateral spaces faintly shaded with dull red; horns pale. Dorsal depressed spaces (1) cleft-like with paired dots. In shape the larva is thickest through joints 4-5, the outline elliptical;

dorsum flat, sides nearly perpendicular, composed of both lateral and subventral spaces. During the stage the color changes. Dark brown, the subdorsal horns pale yellow, only the long ones visible. Subventral space very narrow, the bulging subventral edge colorless. Length 1.1 to 1.8 mm.

Stage III.—Upper side dark velvety brownish red as far as the upper edge of the lateral horns; subdorsal horns on joints 3, 4, 5, 8, 11 and 12 large, thick, light yellow, the short horns not showing; lateral horns all small and with the subventral space light yellow. Skin obscurely finely granular. Dorsal pale dots paired, very faint. The short subdorsal horns have one spine only. Length 1.8 to 3 mm.

Stage IV.—(Plate II, Fig. 2.) As before. Color velvety red-brown, the long horns and subventral region pale yellow; a white line along subventral edge. Later the long horns become orange at the tips and a straight white line appears along the middle of the sides between the subdorsal and lateral horns, broken segmentally. Body high, sides nearly perpendicular, horns erect. The short subdorsals have two or three spines and are situated as before adjacent to the long ones. Length 3 to 4.5 mm.

Stage V.—The six pairs of long horns prominent, thick, alike and well spined; bright red; the four short ones small, rounded, inconspicuous, yet reddish. A faint pinkish dorsal line and traces of one along the subdorsal ridge, ill defined on the dark purple ground which reaches to the lateral horns. Lateral horns faintly pinkish. Subventral region colorless, white on the lower edge. Later in the stage all the horns are fine red and three pale lines can be seen, an addorsal pair besides the dorsal, these new lines faint and broken by the large horns. Also three pale lines in the lateral space, one above and one below the original lateral line. Length 4.5 to 7 mm.

Stage VI.—Horns short at first and pale, but they quickly grow. Color all purple brown, the horns red. Dorsum with three bluish white lines, the outer ones waved and indistinct, lateral space with three yellowish white lines, only the middle one distinct; subventral space with two white lines; obscure red lines along the two rows of horns. Skin finely clear granular. Later the broad lateral pale line and subventral edge may be tinged with red. Length 7 to 10.5 mm.

Stage VII.—The purplish black ground is now so much narrowed that it appears rather as dark lines on a pale ground. Dorsal space contracted at joints 3, 4, 5, 8, 11 and 12, traversed by three bluish white and four purple lines, somewhat broken. Subdorsal ridge whitish

above, broadly red centrally, the horns bright red. Sides blackish purple, a broad lateral line and the subventral edge red; a narrow whitish line above and below the lateral red line, the upper broken. A broad pale stigmatal line. Lateral horns red. Spines pale with black tips; skin clear granular. Small patches of caltropes are present on the tips of the lateral horns on joints 6 to 12 in eighth stage larvæ. Length, 10.5 to 16 mm.

Stage VIII.—(Plate II, Fig. 3) Shape as described. The blackish lines are now still narrower and appear plainly as lines. Dorsal space bluish white with four black lines, waved and confluent opposite the large horns. The rest of the ground color pale yellow, the horns fiery red. Red bands along subdorsal and lateral ridges, in the middle of lateral space and along subventral edge. Sides with four black lines, subconfluent in pairs; subventral area with two black lines. Joint 2 purplish; venter honey brown. The red side-band is partly cut by the pale, dark centered, depressed spaces (4); spaces (1) small, paired, dark. Skin clear granular (Plate II, Figs. 4 and 6). Caltrope patches (Plate II, Fig. 10) present on the lateral horns of joints 6 to 12 and the subdorsal of joint 13. Spines enlarged at base, pale with black tips (Plate II, Fig. 8). Length, 16 to 22 mm.

In the yellow form all the red markings are bright yellow. It did not come under observation in the early stages, but doubtless differs from this only in the absence of red, beginning with stage IV. The yellow form seems the more generalized of the two.

Food-plants.—The larvæ feed on various kinds of low brush. I have notes of finding them on wild cherry, oak, hickory and bayberry.

EXPLANATION OF PLATE II.

- Fig. 1. Larva in stage I, side view, enlarged.
 " 2. Larva end of stage IV, dorsal view, enlarged.
 " 3. Full grown larva, enlarged.
 " 4. Skin granules from the region of the subventral ridge $\times 50$, showing setæ iii and iv.
 " 5. Base of same seta $\times 175$.
 " 6. Skin granules from region of subdorsal ridge $\times 175$.
 " 7. Abnormal skin granules from region of joint 2 $\times 175$.
 " 8. End of one of the large horns $\times 50$, showing the wrinkled skin and spines.
 " 9. Tip of a stinging spine $\times 175$.
 " 10. Caltropes in position $\times 175$.
 " 11. Moth of *Euclea indetermina*.